DIGESTION IN FEVER.[1]

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From time immemorial it has been quite universally believed that during fever the digestive powers of the system are very greatly impaired, if not altogether abolished. In the standard medical literature of all ages, from Hippocrates to the present time, this doctrine is either explicitly stated or implicity conveyed. The belief has had a profound influence on medical practice, being one of the influential considerations leading to the low dietary regimen that has in all times almost universally prevailed in the treatment of acute diseases.

Although this belief still has a strong hold and strongly influences medical practice, it will, perhaps, not be unprofitable critically to consider its basis and validity, and to attempt to determine the exact condition and extent of the digestive processes and powers during fever.

On a general view, it seems almost self-evident that in such a profound disturbance of the body functions as occurs in fever, digestion must necessarily be enormously lowered. Such a belief accorded well with the views as to the nature of the febrile process that dominated medical thought throughout most of medical history. So plausible, indeed, is this belief, from the general conditions present in many cases of fever, that it is quite natural that it should have become a settled conviction; and strong evidence may justly be demanded to shake or modify it. Nevertheless, such a basis for this doctrine can be characterized only as a deductive generality, whose validity to be maintained must stand the test of a scientific and logical critique.

Clinical and general experience may be appealed to in support of the view of abolished digestion in fever. On its face this seems a consideration of the utmost weight, yet, as Hippocrates said, "experience is fallacious and judgment difficult," and the history of medicine shows that the appeal to the results of experience is an argument to be accepted with great caution. Many theories and systems and methods of practice for a time have enjoyed universal approval and claimed justification on the basis of general experience, which nevertheless in the end were found erroneous and were utterly discredited. Preconceived opinions are apt to interfere with unbiassed interpretation of results; and the occurrence of disturbed conditions in a few cases is apt to impress the mind unduly, so that conditions that are really exceptional are taken to be the rule.

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The usual occurrence of anorexia in fever is commonly regarded as a reason for withholding food. It should be noted, however, that loss of appetite does not necessarily imply loss of digestive power. Experiments with absolutely unpalatable and untempting diets (such as ash-free diets) have shown that such food is digested as completely as ordinary appetizing food (Pavlov's teachings to the contrary notwithstanding).

The dry mouth and tongue in many febrile cases have naturally suggested a diminution or suppression of salivary secretion and digestion in fever.

Numerous investigations of gastric digestion during fever have been made.

Beaumont from his classical researches (1833) claimed that in the "febrile diathesis" very little or no gastric juice is secreted and digestion is much impaired; the conceptions of fever at that time, however, were very vague, and it would appear from his protocols that his subject did not at any time during the experiments suffer from real fever, but only from transient attacks of acute indigestion.

Investigations by modern methods (*i. e.*, the stomach tube) have shown that in the various fevers there is usually a diminution or total suppression of hydrochloric acid in the gastric juice, while the pepsin is apparently but little reduced. Gastric absorption has been found materially retarded in fevers, while von Noorden found the motor functions of the stomach little impaired.

Special studies of pancreatic and intestinal digestion in fever have naturally not been made, owing to the inaccessibility of these regions to investigation.

Inasmuch as the bulk of digestion is carried on by the pancreatic and intestinal secretions, concerning which we have no specific data, it is apparent that the observations at hand indicating some lowering of gastric secretion are not sufficient basis for any reliable judgment as to the total impairment of digestion in fever.

Fortunately we have at command a simple, accurate, and conclusive means of determining the exact degree of the total net digestion and absorption of the various foodstuffs in patients with fever—the same standard method by which the quantitative digestion of food in health is determined—a method available and easily applicable for any subject. This consists in making exact determinations of the food materials (protein, fat, carbohydrate) ingested during a certain period, and also of these same materials as discharged in the feces for the same period. The difference between the material ingested and that dejected necessarily represents the amount digested and absorbed. The estimation of protein is based on a determination of the total nitrogen (Kjeldahl method) in the food and feces, that of fat on the material extractible by ether. As a certain though indeterminate portion of the nitrogen and ether extract in the feces is derived from excretions into the alimentary canal, desquamated epithelium, bacteria, etc. (and not from the food), the digestion is always more complete than the figures indicate. The error thus introduced is of considerable magnitude with small diets, and should be discounted in interpreting such, but with ample diets is of smaller moment and does not vitiate the method for purposes of comparison.

In order to form an exact estimate of the degree of impairment of digestion during fever by this method, I have collected all the reports of analyses of food and feces in febrile diseases which I could find published. These cover 155 cases (1386 days of observation in all) in which determinations of nitrogen (protein) in food and feces were made, and 31 cases (154 days of observation) in which fat determinations were made. These estimations were made by thirty-six different investigators for various purposes. Practically no determinations of carbohydrate were found, and consequently there are no data on which to base a specific judgment as to its digestibility; but carbohydrate is usually digested much more completely than protein or fat, and it is highly probable that in fever the falling off in its digestion is no greater (and is probably less) than that of protein or fat. While there is ample room for further investigation, the data thus collected are sufficient for the formation of at least a tentative estimate of the impairment of digestion and absorption of protein and fat during fever.

The data are presented in the two accompanying tables, giving the general daily averages in food and feces during actual pyrexia of protein (nitrogen) and fat respectively. The actual diets in the various cases varied greatly both as to the amounts and the kinds of food used; many of the patients were on diets consisting largely or exclusively of milk, while many received a well-mixed diet. On account of the large error with small diets, cases in which the daily nitrogen intake was less than 5 grams have for the most part (except in children) been excluded from the compilation.

General Averages per Diem of Determinations of Digestion and Absorption of Protein (Nitrogen) During Periods of Fever in Various Diseases.

Disease.	Number of observers.	Number of cases studied.	Number of days of observation.	Nitrogen in food, daily average. Grams.	Nitrogen in feces, daily average. Grams.	Percentage of food protein (nitrogen) absorbed.
Typhoid fever	20	71	716	11.7	1.9	83.6
Typhus fever	2	15	81	9.9	1.4	85.7
Relapsing fever	1	1	6	7.6	1.1	86.2
Tuberculosis, pulmonary	11	33	323	21.0	2.6	88.3
"Chronic pneumonia" (probably including cases of phthisis)	3	6	79	11.8	1.4	87.8
Acute pneumonia	4	20	103	10.2	1.4	86.1
Acute pleuritis	2	2	14	9.8	1.9	80.6
Suppurative pyelonephritis	1	1	17	19.1	1.7	91.1
Scarlatina	1	6	44	5.3	0.6	88.6
Totals and general averages (by cases)	35	155	1386	13.3	1.9	86.0
Cases on exclusive milk diet		32	165	10.5	1.4	86.5

General Averages per Diem of Determinations of Digestion of Fat During Periods of Fever in Various Diseases.

Disease	Number of observers	Number of cases studied.	Number of days of observation.	Fat in food, daily average. Grams.	Fat in feces, daily average. Grams.	Percentage of food fat absorbed.
Typhoid fever	3	16	91	59.3	5.0	91.6
Typhus fever	1	4	18	23.4	3.9	83.2
Relapsing fever	1	2	8	25.8	4.4	83.1
Intermittent fever	1	1	6	19.4	2.6	86.6
Erysipelas	1	2	6	36.0	7.5	79.3
Tuberculosis, pulmonary	3	3	14	59.5	4.8	91.9
Acute pneumonia	1	2	8	22.3	4.7	78.9
Varioloid	1	1	3	43.4	5.7	86.9
Totals and general averages (by cases)	6	31	151	46.8	4.9	89.6
Cases on exclusive milk diet	2	22	81	38.4	4.6	88.0
Cases on diet of egg yolks	1	2	8	128.0	7.5	94.2
Cases on diet of ham	1	3	11	12.5	3.4	72.8
Cases on diet of porridge	1	2	8	84.0	7.1	91.6
Cases on mixed diet	5	8	43	73.9	6.0	91.9

For purposes of comparison the percentages of digestibility of the several foodstuffs in health, as determined by Atwater, may be stated, as follows:

	Protein.	Fat.	Carbohydrate.
Animal food	97	95	98
Vegetable food	84	90	97
Mixed diet	92	95	97

Examination of the figures in the tables shows for protein a general average digestion in fever of 86 per cent. in 155 cases of nine different diseases; this is a falling-off from the normal digestion of 11 per cent. if compared with animal food, or of 6 per cent. if compared with mixed diet, but is 2 per cent. better than the digestion of protein in vegetable food in health.

For fat, the general average digestion in fever in 31 cases of eight different diseases was 89.6 per cent., a falling off from health of 5.4 per cent. as compared with animal or mixed diet, and practically the same as the digestion of vegetable fat in health.

The determinations show no tendency for a lower degree of digestibility with the larger diets. In the typhoid fever cases, for example, the digestion and absorption of the food protein with varying amounts of protein in the daily ration was as follows:

Daily amount of protein in food.	Percentage of food protein absorbed.
Under 25 grams	57.9
25 to 49.9 grams	74.2
50 to 74.9 "	86.0
75 to 99.9 "	86.0
100 to 124.9 "	88.1
125 to 149.9 "	85.0
150 to 174.9 "	88.1
Over 175 grams	84.0

The cases on exclusive milk diet show a digestion of protein only 0.5 per cent. higher than the average, while that of fat is even less than the average. This showing does not support the prevalent belief in the superior digestibility of milk during fever.

In general, so far as shown by the data available, the average reduction of digestion during fever ranges not over 5 to 10 per cent. This falling off is so small as for practical purposes to be almost negligible; indeed, the digestion of animal and mixed food in fever is quite as good as that of vegetable food in health. The belief in a great impairment of digestion in fever is an idea based on vague impressions and dogmatic assumptions that has come down to us from the dark ages of medicine. The reduction actually shown by exact observations is so small as to dispel any fear, in general, of fever patients being unable to digest and absorb an adequate amount of the nutriment offered them, or to necessitate on that account any diminution of the diet.

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HEMORRHAGES OCCURRING WITHIN A BRIEF PERIOD IN A GROUP OF CASES OF PULMONARY TUBERCULOSIS.*

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The rarity with which detailed reports have been published of hemorrhages in groups of cases of tuberculosis, and some features of special interest in the series herewith presented, are the occasion for the present report.

The outbreak occurred at the Home for Consumptives, at Chestnut Hill, Philadelphia, in which there were at the time 66 patients, 10 being incipient cases, 11 moderately advanced, and 45 far advanced. About one-fourth were males and threefourths females. Over one-half were between twenty and forty years of age. These figures, except that the total number of cases is a little low, correspond closely to the daily average at the Home. During the whole year 135 cases of pulmonary tuberculosis were under treatment, and during this time 43, or about one-third, expectorated blood at one time or another. The numbers expectorating blood each month were 11 in May, 15 in October, and in the remaining months varied from 2 in February to 9 in December. The longest period of absence from hemorrhage was sixteen days, from May 20 to June 4. There were two periods in which the hemorrhagic cases were concentrated, one from April 21 to May 19, in which 12 cases spat blood, and the period under consideration.

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A glance at the table shows that in the brief period of three weeks, from September 30 to October 20, there were 14 individual cases expectorating blood, or between one-fifth and one-sixth of all the patients in the Home at the time, and about one-third of all the patients who expectorated blood throughout the entire year. On only one day of this period was there no patient spitting blood. During the previous three weeks only 4 cases and during the subsequent three weeks only 2 cases had hemorrhages. This is a large proportion of cases, even when compared to the frequency of hemorrhages in all cases of tuberculosis. This frequency varies, according to different statistics, from about one-fourth to over four-fifths of all cases, depending on the class of cases and the time they are under observation.

The patients at the Home are distributed pretty equally in four separate buildings, which are united by enclosed passages, and the number of hemorrhagic cases in this series was about equal in each building.

All of these 14 cases had expectorated blood at some time previously, but a considerable period had intervened in most of them, over three months in 5 cf the cases; 1 incipient case was admitted during the outbreak and expectorated blood for the first time in a month.

The first case to develop hemoptysis during this outbreak was quite subject to hemorrhages. She had had streaky sputum a month before, and again two days before the first date given in the table, when she had a hemorrhage of eight ounces. Every day or two following for three weeks some new case would spit blood.

Besides the number of hemorrhagic cases in this series their severity is noteworthy; 6 of the 14 raised pure unmixed blood, and of these, 3 died immediately from the effects of the hemorrhage and a fourth expectorated twenty-four ounces of blood and died twenty-five days later without any recurrence of the hemorrhage. During the whole year 31 cases at the Home terminated fatally. Anders[1] records only 10 immediately fatal cases of hemorrhage out of 5302 cases. West[2] estimates that 1 to 2 per cent. of all deaths in phthisis are due to fatal hemorrhages.